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Banking systems, innovations, intellectual property protections, and financial markets: Evidence from China ☆

Po-Hsuan Hsu [a], Chong Wang [b], Chaopeng Wu [c,*]

[a] University of Hong Kong, Hong Kong
[b] Naval Postgraduate School, United States
[c] Xiamen University, China

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ABSTRACT

One unique feature of the emerging economies in Asia is the rich variation in the development of financial systems and technological sectors across different geographical areas. This unbalanced evolution provides us a potentially more powerful setting to investigate the dynamics among banking systems, innovations, intellectual property (IP) protections, and stock market reactions that are especially useful in understanding the policy–finance–innovation nexus in emerging economies. Using newly available data from China, this study confirms the nurturing role of financial systems on innovations, the value-enhancing function of firms' innovative activities, and the lead–lag predictive role of innovations on stock returns, in the context of emerging economies. More importantly, the study documents that stronger provincial IP protections reduce patent piracy and hence enhance local firms' market values.

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1. Introduction

As one of the major emerging economies, China has experienced remarkable development in both financial and technological sectors during the last three decades. While this progress is significant at the country level, the impact across different geographical regions is nevertheless uneven. This unbalanced evolution naturally creates rich variations across different provinces, in terms of financial and technological characteristics. Such variations, which are a somewhat unique feature in emerging economies, provide us with a potentially more powerful setting to investigate the relations among banking systems, innovations, intellectual property protections, and stock market reactions that are especially useful in understanding the perspectives of emerging economies.

This study analyzes the policy–finance–innovation nexus in the context of China by analyzing a unique province-level and firm-level dataset. On the nurturing roles of banking systems on innovations, this paper documents that one standard deviation increase in the local credit market index which boosts local patent output by at least 14%. On the market's valuation of intangible assets associated with innovation, this study demonstrates that firm-level patent capital and province-level intellectual property (IP) protections which strongly and positively explain public firms' market values. One standard deviation change in patent capital and IP protections moves the market value by at least 1.2% and 1.5%, respectively. On the lead–lag predictive role of innovations on stock returns, one standard deviation increment in a firm's patent flow increases its future stock returns by 0.05%–0.10% per month.

In summary, this study's first contribution to the literature is to confirm the important role of financial systems and legal environments in promoting innovation, the value-enhancing function of firms' innovative activities and IP protections, and the lead–lag predictive role of innovations on stock returns, in the context of emerging economies. Although these important relations have been reported in prior studies using the data of developed countries, no studies systematically investigated whether similar results would hold for emerging economies. The authors would like to point out that it is not given that empirical regularities documented in developed countries would automatically prevail in emerging economies, due to different institutional environments.

The major contribution of this research is to document the effect of *provincial* IP protections on public firms' market values. This finding is important because unlike developed countries, emerging economies have enormous degrees of asymmetric development across various geographical regions. Past studies using data from developed countries focused on industrial IP protections. To the best of our knowledge, this study is the first to find that stronger provincial IP protections enhance local firms' market values.

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* Corresponding author at: Xiamen University, School of Management, 361005, China. Tel./fax: +86 592 2187130.
E-mail address: wuchaopeng@xmu.edu.cn (C. Wu).

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2. Relevant literature and hypotheses development

The literature has long recognized the positive effect of banking development on real economies. For instance, King and Levine (1993) argue that better-developed financial intermediaries can efficiently fund promising entrepreneurs and, hence, improve the society's innovation progress. Benfratello, Schiantarelli, and Sembenelli (2008) empirically examine this proposition and find that banking development spurs local firms' innovative activities. This research expects that the nurturing role of banking systems on innovation is even stronger in China. First, debt financing plays a dominant role relative to equity financing in China (Allen, Qian, & Qian, 2008). A recent study by Wang (2010) confirms the leading role of China banks in promoting innovations. Specifically, he employs the Directed Acyclic Graph (DAG) model to perform a path analysis for the high-tech firms in China, and finds that the debt financing leads and positively affects the investment in both tangible and intangible assets. Secondly, significant variation in the development of provincial banking systems is present in China due to the fast yet uneven growth since 1978 (Fan, Wang, & Zhu, 2009; Wang, Wong, & Xia, 2008). The rich cross-regional variation provides us a more powerful setting to detect such causal relationship. This study thus develops the first hypothesis, as follows:

H1. Better developed local banking systems lead to more local innovations in China.

Extant literature based on developed countries documents that knowledge capital, measured with the stock of Research and Development (R&D) expenses and patents, are valued by stock markets. The first work in this direction is Griliches (1981), in which R&D capital and patent capital adjusted for asset size explain the Tobin's q of 157 U.S. firms in 1968–1974. Ben-Zion (1984) uses the same data set and reports that firms' R&D and patent flow explain their market values. Several subsequent studies based on extensive U.S. and European data provide concurring results (Blundell, Griffith, & Van Reenen, 1999; Hall, 1993; Hall, Jaffe, & Trajtenberg, 2005; Hall, Thoma, & Torrisi, 2007; Lerner, 1994). Motivated by the aforementioned studies and realizing the fruitful impact of China's three-decade transition from a centralized socialist economy to the free market economy, this study hypothesizes that a similar relation should prevail in China as well:

H2A. The market values of China's public firms increase with their technology capabilities measured by patents.

The role of IP protections on stock market valuation is relatively underdeveloped in the literature. Cockburn and Griliches (1988) find that industry-level patent protection serves as an intermediary variable that enhances stock markets' evaluation of firms' R&D capital and patent capital. Lerner (1994) also reports consistent results by showing that, in the biotechnology industry, firms' market values rise with patent protection. In addition, Schankerman (1998) reports that the private returns to R&D increase with patent protections in different industries in France. These studies on IP protections almost exclusively focus on either intra-industry or inter-industry variations. While an emphasis on industry based variation may make good sense in the U.S. and other Western countries, the provincial variation warrants more attention in China and other large emerging economies. The rationale is that, in contrast to the developed countries, emerging economies have enormous degrees of asymmetric development across various geographical regions. By extending the argument of the aforementioned studies along the geographic dimension, this study hypothesizes the following:

H2B. Firms located in the provinces with better IP protections enjoy higher market values in China.

The literature also suggests that innovations lead stock returns. The pioneering work of Pakes (1985) investigates the dynamics among patent flows, R&D flows, and annual stock excess returns in a data set composed of 120 firms from 1968 to 1975. Later, Lev and Sougiannis (1996) and Chan, Lakonishok, and Sougiannis (2001) document an interesting phenomenon that R&D intensive firms, measured with R&D flow or capital over sales or market value, provide higher subsequent stock returns. Deng, Lev, and Narin (2003) report that U.S. high-tech firms' patent flows significantly forecast stock returns. Eberhart, Maxwell, and Siddique (2004) find that an unexpected rise in R&D expenditures leads to significantly higher stock returns. Such predictability can be attributed to behavioral reasons such as slow information flow or myopia (e.g., Chan et al., 2001; Eberhart et al., 2004) or rational explanations such as productivity and efficiency improvement (e.g., Lin, 2009). All these factors could also exist in China due to its relatively short history of stock markets, less sophisticated investors, and the private sector's fast adoption of latest technologies. Therefore, the last hypothesis of this study conjectures the following:

H3. A lead–lag relationship exists between firms' innovations and stock returns in China.

3. Data

The data comes from several sources, as elaborated later. The authors report summary statistics in Table 1. Panel A includes all province-year variables. The credit market index (denoted as *Credit*), available from Wang et al. (2008) and Fan et al. (2009), is constructed to measure provincial banking development for the period of 1999–2007. A higher index refers to a more developed credit market.

The authors then collect the number of the patents filed in each province since 1991 from the State Intellectual Property Office (hereafter SIPO). *ln (Pat)* denotes the log number of all provincial patents filed in each year. The total R&D expenses in both public and private sectors in each province for the period of 1991–2007 are obtained from the China Science and Technology Statistical Yearbook (2009). *ln (Total R&D)* is the logarithmic number of the total R&D expenditures in

Table 1
Summary statistics.

	Mean	Median	St. dev.	10%	90%	Sample period
Panel A						
Credit	5.34	5.31	2.37	2.12	8.52	1999–2007
ln (Pat)	7.81	7.90	1.48	6.10	9.51	1991–2007
ln (Total R&D)	14.84	14.94	1.49	12.94	16.67	1991–2007
ln (GDP)	7.75	7.88	1.11	6.29	9.05	1991–2007
Deposits	2.15	1.22	3.08	0.54	4.11	1999–2007
Loans	1.53	0.96	1.83	0.47	3.10	1999–2007
IP protection	8.38	6.66	7.46	3.46	13.21	2002–2007
R&D/Pat	0.94	0.25	0.17	0.01	2.62	1991–2007
R&D/Tech	0.32	0.31	0.23	0.21	0.40	1991–2007
Patent law firms	0.16	0.11	0.17	0.06	0.28	2002–2007
Panel B						
Patent flow	3.37	0.00	50.21	0.00	3.00	1991–2007
Patent capital (Pat)	9.31	0.00	127.06	0.00	10.00	1991–2007
Patent flow/S	0.002	0.00	0.02	0.00	0.003	1991–2007
Pat/A	0.003	0.00	0.01	0.00	0.01	1991–2007
ln (MV)	21.21	21.26	1.29	19.96	22.58	1991–2007
ln (A)	21.08	20.97	1.17	20.03	22.36	1991–2007
D/E	1.26	0.88	2.73	0.25	2.41	1991–2007
d ln (S)	0.11	0.12	0.55	−0.29	0.50	1991–2007
Market beta	1.00	0.99	0.24	0.75	1.24	1991–2007
ln (B/M)	−0.35	−0.34	0.75	−1.31	0.61	1991–2007
Investment	0.06	0.04	0.08	0.00	0.15	1991–2007
State ownership	0.32	0.34	0.26	0.00	0.66	1991–2007
Panel C						
Excess stock return	0.02	0.00	0.17	−0.13	0.18	Jan. 1991–Dec. 2007
Momentum	0.19	0.05	0.59	−0.39	1.00	Jan. 1991–Dec. 2007

10,000 RMB in each province in every year. The provincial population and Gross Domestic Product (GDP) data come from the China Statistical Yearbook (2009). *ln (GDP)* denotes the logarithmic number of provincial GDP in 100 million RMB. The authors also collect the total bank deposits per capita and the total bank loans per capita in 10,000 RMB in each province for the period of 1999–2007 from the Almanac of China's Finance and Banking (2009), denoted as *Deposits* and *Loans*, respectively. In addition, using *China Science and Technology Statistical Yearbook*, the authors construct a provincial IP protection index (denoted as *IP protection*), that is, the number of registered patent agents who are chartered to handle general IP issues over the number of scientists and engineers in that province for the period of 2002–2007. The maintained assumption of this index is that a higher patent agents-to-innovation workers ratio leads to better patent protection of IP. The density of patent law firms, denoted as *Patent law firms*, is the annual number of registered patent law firms in every province, divided by the number of innovation works. This study also collects the private R&D-to-patent ratio (*R&D/Pat*) and R&D-to-scientists and engineers ratio (*R&D/Tech*), which measures the monetary price of each patent and the R&D expenses per innovation worker for each province-year, respectively.

Panel B includes all firm-year variables. The data source for the financial market and accounting data of all China's public firms is the China Stock Market & Accounting Research (CSMAR) Database. The sample includes 1775 domestic firms that issue A shares in the Shanghai Stock Exchange and Shenzhen Stock Exchange, in the period of 1991–2008. The upper panel of Fig. 1 illustrates the annual counts of valid sample firms.

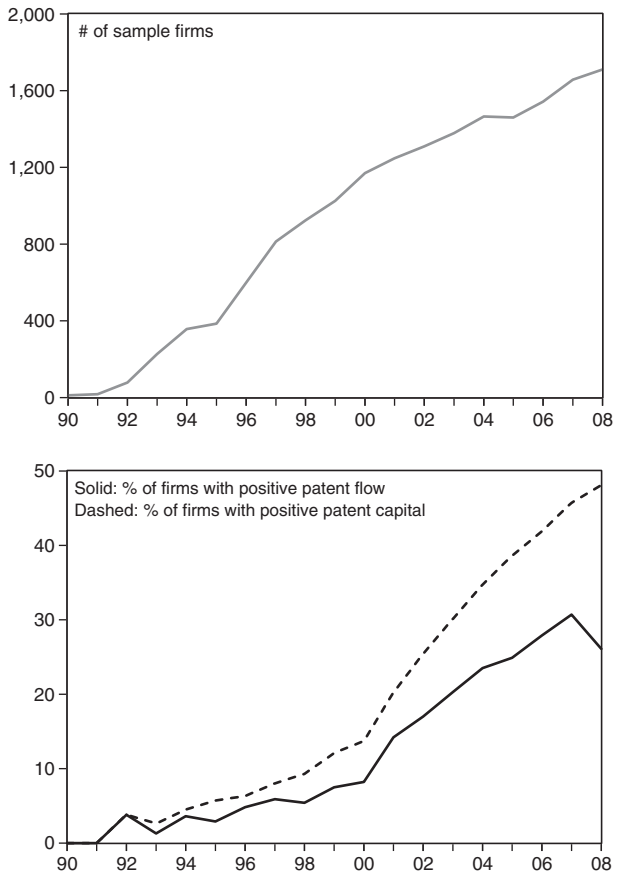

Fig. 1. The number of sample firms and the percentages of sample firms with patents. The upper panel presents the number of sample firms in 1991–2007. The lower panel shows the percentage of every year's sample firms with positive patent flow (solid) or positive patent capital (dashed) for the sample period 1991–2007.

This research defines the geographic locations of public firms as the provinces where their headquarters are located (from the CSMAR database), as public firms' headquarter locations play an influential role in market valuation (Coval & Moskowitz, 1999). It is worth noting that the location choices of China's public firms tend to be an outcome of natural experiment for several reasons, including (1) the majority of public firms are state-owned, (2) the relatively short history of modern stock markets in China, and (3) the low mobility of the general public across provinces.

The authors then collect each public firm's annual patent counts by manually searching the patent database of the SIPO. A firm's patent counts in a specific year denote the number of successful patent applications that are filed by the firm in that year. Since public firms in China rarely report R&D expenditures, patent data are extremely important as relevant proxies of knowledge flow and capital. This patent search procedure generates a total of 58,608 patents, in three mutually exclusive categories, namely, invention patents (49%), utility model patents (32%), and design patents (19%). It is quite impressive that 839 firms (47%) out of a total of 1775 own at least one patent by the end of 2007. However, when restricting the sample to the end of 2000, only 160 firms (14%) out of 1172 have patent records. This indicates that, similar to what happened in the U.S. in the 1980s (Hall & Ziedonis, 2001), China's companies realize how important and valuable patents are and have rapidly increased their innovations and patenting activities in the last decade. The lower panel of Fig. 1 illustrates the time series of the fraction of the sample firms with any patent count in a given year (solid line), and the fraction of sample firms with any patent count by a given year (dashed line). These ratios are very low in the first few years, then escalate during 1993–1999 and surge after 2000. The drop of the solid line in the last year is simply due to the application-approval lag (i.e., some patents may have been filed but not yet officially approved by the SIPO).

In panel B of Table 1, *Patent flow* represents a firm's patent counts in a specific year, and *Patent flow/S* denotes the firm's patent counts over its total sales in 1,000,000 RMB. *Patent capital* serves as a proxy of a firm's knowledge capital and is the cumulative patent counts with 15% obsolescence rate in each year, following Hall et al. (2005). *Pat/A* denotes the firm's patent capital over its total assets in 1,000,000 RMB. This study also considers other important variables as follows. *ln (MV)* and *ln (A)* denotes the logarithmic numbers of the firm's market value and total assets, respectively. *D/E* denotes the firm's debt-to-equity ratio, *d ln (S)* denotes changes of logarithmic sales, *Market beta* denotes the coefficient from regressing the firm's monthly excess stock return on total stock market's monthly excess return, *ln (B/M)* denotes the logarithmic number of the firm's book-to-market ratio, *Investment* denotes the firm's capital expenditures over its total assets. The authors also construct state ownership percentage for each firm-year (denoted as *State ownership*), which is included in all firm-level tests to control for potentially unobserved factors related to state ownership, if any.

Panel C of Table 1 contains two firm-month variables. *Excess stock return* denotes a public firm's monthly stock return in excess of the three-month interest rate of bank deposits from the People's Bank of China. *Momentum* denotes the accumulated monthly returns on each stock over the past 12 months.

4. Empirical tests

4.1. Local banking development and innovations

Table 2 empirically tests the first hypothesis (H1) that local banking development promotes local innovative activities. Local banking development is measured with the provincial credit market index, while local innovative activities are measured with the provincial patent flow (*ln (Pat)*), defined as the logarithmic number of annual patents originated from each province every year (e.g., Hausman, Hall, &

Table 2
Provincial banking development and innovations.

Panel A: OLS regression				
	(1)	(2)	(3)	(4)
Dependent	ln (Pat)	ln (Pat)	ln (Pat)	ln (Pat)
Credit	0.891**	0.212**	0.188**	0.141**
	(0.066)	(0.040)	(0.038)	(0.035)
ln [total R&D]			0.190**	0.104
			(0.058)	(0.069)
ln [total R&D (t − 1)]				0.137*
				(0.070)
IP protection				0.192**
				(0.052)
IP protection X Credit				0.078**
				(0.029)
ln (GDP)				0.333**
				(0.166)
SO				0.066
				(0.201)
SO (financial)				−0.260**
				(0.108)
Constant	8.012**	7.537**	0.842	1.717
	(0.054)	(0.176)	(0.599)	(1.17)
Year dummy	No	Yes	Yes	Yes
Province dummy	No	Yes	Yes	Yes
R-square (%)	35.9	97.3	97.6	97.9
Observations	431	431	427	394
Panel B: 2SLS regression				
Second stage				
	(5)	(6)	(7)	(8)
Dependent	ln (Pat)	ln (Pat)	ln (Pat)	ln (Pat)
Credit	1.366**	0.746**	0.762**	0.529**
	(0.119)	(0.112)	(0.114)	(0.128)
ln [total R&D]			0.022	0.041
			(0.070)	(0.128)
ln [total R&D (t − 1)]				0.099
				(0.076)
IP protection				0.092*
				(0.054)
IP protection X Credit				0.081**
				(0.033)
ln (GDP)				0.062
				(0.225)
SO				−0.026
				(0.219)
SO (financial)				−0.305**
				(0.127)
Constant	8.179**	8.729**	8.315**	7.276**
	(0.069)	(0.244)	(1.135)	(2.754)
Year dummy	No	Yes	Yes	Yes
Province dummy	No	Yes	Yes	Yes
R-square (%)	26.2	95.5	95.5	97.0
Observations	400	400	397	394
First stage (credit)				
Deposits	−0.322**	−0.470**	−0.429**	−0.379**
	(0.078)	(0.113)	(0.114)	(0.159)
Loans	0.812**	0.872**	0.818**	0.879**
	(0.125)	(0.175)	(0.174)	(0.241)
J stat. for valid instruments	10.396	3.433	3.718	0.017
	[0.001]	[0.064]	[0.054]	[0.897]

Note: Heteroscedasticity-consistent standard errors are shown in parentheses.
* Indicate the coefficient is statistically significant at the 10-percent level.
** Indicate the coefficient is statistically significant at the 5-percent level.

Griliches, 1984). The authors conduct pooled ordinary least squares (OLS) regression by regressing annual provincial patent flow on the provincial credit market index in the prior year, with and without other control variables for the sample period of 1991–2007. The provincial credit market index has been standardized for interpretational purposes. Models (1) and (2) show that a higher provincial credit market index leads to significantly more provincial patents in the next year, regardless of the appearance of year and province dummies. Such a relation is confirmed in Models (3) and (4), after controlling for contemporaneous provincial R&D expenses, lagged provincial R&D expenses, contemporaneous provincial GDP, lagged IP protection index, the interaction between lagged provincial credit market index and lagged IP protection index, the average of state ownership percentages, and the average of state ownership percentages in financial industry. Even with the existence of these control variables, the explanatory power of the credit market index remains economically meaningful: one standard deviation increase in the credit market index raises local patents by more than 14% per year.

To address the potential endogeneity issue, this study conducts a two-stage least squares (2SLS) regression with two instrumental variables (IVs) in panel B, namely, the provincial bank deposits and loans per capita. The two IVs reflect the use of banks in different provinces and, hence, should closely relate to the credit market index. On the other hand, they should not affect local innovations as they are unrelated to the will to innovate, and R&D expenses have been included on the right hand side. The maintained assumption is that the R&D investment and the will to patent are two main determinants of provincial patents. Panel B shows that, in the first stage, deposits per capita negatively affect the credit market index, and loans per capita positively affect the credit market index. This finding is intuitive as the saving rate in China was known to be too high in the past. The second stage estimation suggests that local banking development still significantly raises local innovating activities, regardless of the existence of all related control variables. The bottom of panel B also reports the J-statistics for the validity of IVs (Baum, Schaffer, & Stillman, 2003, 2007; Hansen, 1982).

It is worth mentioning that the coefficients associated with IP protections are significantly positive, which is expected as inventors are motivated to create more innovations with better IP protections. This finding is consistent with the literature that investigates the impact of IP protections on innovations in developing economies (e.g., Ang, Cheng, & Wu, in press; Chen & Puttitanun, 2005; Lin, Lin, & Song, 2010; Sheng, Zhou, & Lessassy, 2012). Additionally, the coefficients associated with the interaction between IP protections and credit market are also significantly positive, suggesting substantial synergy of financial development and legal environment in promoting innovations.

4.2. Knowledge capital, IP protection, and market value

H2A and H2B conjecture that knowledge capital and IP protections positively affect the market values of China's public firms. Table 3 reports strong evidence supporting these propositions.

The authors first employ pooled OLS regressions with each sample firm-year's logarithmic market value, *ln (MV)* (i.e., stock price multiplied by the number of outstanding shares at the end of the year), as the dependent variable. This study focuses on innovative firms (i.e., firms with positive patent capital) for better testing power because their market values depend on IP and are more sensitive to IP protections. Three important explanatory variables on the right hand side are worth noting: the firm's physical capital, the firm's knowledge capital, and the provincial IP protection. Patent capital and the IP protection index are standardized by their means and standard deviations for interpretational purposes.

Panel A of Table 3 presents the estimated results from regressing the firm's logarithmic market value on its patent capital, logarithmic total assets, and corresponding provincial IP protection index, along with other control variables including provincial credit market index, leverage degree, changes in sales, GDP, state ownership, and the interaction between IP protection and state ownership, year dummies, and industry dummies. The coefficients associated with patent capital and the IP protection index are positive based on

Table 3
Firms' market values, knowledge capital, and provincial IP protections.

Panel A: OLS regression		
	(1)	(2)
Sample firms	Positive Pat/A	Positive Pat/A
Dependent	ln (MV)	ln (MV)
Pat/A	0.019**	0.022**
	(0.007)	(0.010)
IP protection	0.062**	0.015
	(0.008)	(0.014)
ln (A)	0.689**	0.676**
	(0.010)	(0.011)
Credit		0.009*
		(0.005)
D/E		−0.008**
		(0.003)
d ln (S)		0.188**
		(0.026)
ln (GDP)		−0.009
		(0.015)
SO		0.133**
		(0.037)
IP protection X SO		0.104**
		(0.028)
Constant	0.351	−0.012
	(0.203)	(0.340)
Year dummy	Yes	Yes
Industry dummy	Yes	Yes
R-square (%)	78.1	78.7
Observations	4698	3636
Panel B: 2SLS regression		
Second stage		
	(3)	(4)
Sample firms	Positive Pat/A	Positive Pat/A
Dependent	ln (MV)	ln (MV)
Pat/A	0.166**	0.251**
	(0.060)	(0.102)
IP protection	0.064**	0.032
	(0.010)	(0.020)
ln (A)	0.714**	0.728**
	(0.017)	(0.027)
Credit		−0.008
		(0.010)
D/E		−0.007**
		(0.003)
d ln (S)		0.181**
		(0.028)
ln (GDP)		−0.053**
		(0.027)
SO		0.162**
		(0.049)
IP protection X SO		0.071**
		(0.36)
Constant	0.479	−0.339
	(0.403)	(0.487)
Year dummy	Yes	Yes
Industry dummy	Yes	Yes
R-square (%)	73.5	66.5
Observations	3779	3550
First stage (Pat/A)		
R&D/Pat	−0.135**	−0.081**
	(0.018)	(0.013)
R&D/Tech	−0.016	0.069
	(0.037)	(0.043)
Patent law firms	0.084	−0.046
	(0.133)	(0.220)
First stage (IP protection)		
R&D/Pat	−0.003	−0.07
	(0.005)	(0.042)
R&D/Tech	0.134**	0.068**
	(0.010)	(0.021)
Patent law firms	4.322**	3.855**
	(0.042)	(0.079)
J stat. for valid instruments	0.021	1.417
	[0.886]	[0.234]

Note: Heteroscedasticity-consistent standard errors are shown in parentheses.
* Indicate the coefficient is statistically significant at the 10-percent level.
** Indicate the coefficient is statistically significant at the 5-percent level.

heteroscedasticity-robust standard errors in all four models. Note that one standard deviation increase in patent capital (IP protection index) increases the firm's market value by 1.9% to 2.2% (1.5%–6.2%).

To mitigate the potential endogeneity concern, the authors conduct the 2SLS regressions with three IVs: the private R&D-to-patent ratio, the R&D-to-scientists and engineers ratio, and the density of patent law firms.

The first stage estimation suggests the following: first, the private R&D-to-patent ratio has a significantly negative effect on patent capital; second, the R&D-to-scientists and engineers ratio and the density of patent law firms positively relate to the IP protection index with statistical significance. The second stage estimation confirms the positive effects of knowledge capital and IP protections on stock market valuation. The J-statistics does not reject the null hypothesis in Models (3) to (4), supporting the validity of three IVs as they are statistically uncorrelated with the error process.

4.3. Innovations and subsequent stock returns

To examine if technological innovations lead to subsequent abnormal stock returns in China (i.e., H3), the authors perform the pooled OLS regressions by regressing the monthly excess returns of an innovative firm on its patent flow, controlling other firm characteristics in the prior year for the sample period of 1991–2007. The patent flow is scaled by annual sales following Lev and Sougiannis (1996) and Chan et al. (2001), and is standardized. This study uses patent flow instead of capital as the main explanatory variable on the right hand side because stock markets are more sensitive to recent news, and all innovations before the prior year should have been reflected in stock prices. Other firm characteristics include market beta, size and book-to-market ratio, momentum, investment intensity, state ownership, IP protection, the interaction between IP protections and state ownership, year dummies, and industry dummies. For statistical inferences, the authors use the standard errors clustered by years to solve the difference in the frequency between the monthly dependent variables and the annual explanatory variables (see Petersen, 2009).

Table 4 shows that firm-specific patent flow significantly predicts monthly stock returns of innovative firms in China. The authors consider two sample groups: the first group includes the firms with positive patent flow in all industries in Models (1) and (2), while the second group includes only the firms with positive patent flow in six high-tech industries in Models (3) and (4). The six high-tech industries are selected from 22 industry categories. These six industries represent a significant part of patent records in the SIPO's database. They are Chemical, Petrochemicals, and Plastic (C4); Electrical and Electronic (C5); Metal and Nonmetallic (C6); Mechanical (C7); Drugs, Medical, and Biotechnology (C8); and Computers and Communications (G).

Table 4
The patent flow and subsequent stock returns.

Panel A: OLS regression				
	(1)	(2)	(3)	(4)
Industries	All	All	High-tech	High-tech
Sample firms	Positive patent flow	Positive patent flow	Positive patent flow	Positive patent flow
Dependent	Monthly excess returns	Monthly excess returns	Monthly excess returns	Monthly excess returns
Patent flow/S (%)	0.096**	0.054**	0.096**	0.054**
	(0.020)	(0.013)	(0.020)	(0.015)
Market beta	0.008	0.005	0.007	0.002
	(0.012)	(0.014)	(0.012)	(0.013)
ln (MV)	−0.005	−0.005	−0.005	−0.006
	(0.004)	(0.004)	(0.004)	(0.004)
ln (B/M)	0.013**	0.015**	0.013*	0.015**
	(0.006)	(0.006)	(0.006)	(0.007)
Momentum		−0.042**		−0.043**
		(0.020)		(0.019)
Investment		0.002		0.005
		(0.015)		(0.013)
SO		0.000		−0.002
		(0.000)		(0.004)
IP protection		0.000		0.00
		(0.002)		(0.002)
IP protection X SO		0.003		0.005
		(0.003)		(0.004)
Constant	0.087*	0.075	0.115*	0.103
	(0.048)	(0.055)	(0.058)	(0.060)
Year dummy	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes
R-square (%)	10.4	11.66	10.3	11.6
Observations	17,108	16,902	13,284	13,159
Panel B: 2SLS regression				
Second stage				
	(5)	(6)	(7)	(8)
Industries	All	All	High-tech	High-tech
Sample firms	Positive patent flow	Positive patent flow	Positive patent flow	Positive patent flow
Dependent	Monthly excess returns	Monthly excess returns	Monthly excess returns	Monthly excess returns
Patent flow/S (%)	3.129**	4.533**	3.206**	2.114
	(0.711)	(1.971)	(1.037)	(1.613)
Market beta	0.009	0.010	0.008	0.004
	(0.013)	(0.006)	(0.012)	(0.006)
ln (MV)	0.006**	0.010*	0.007	0.002
	(0.003)	(0.006)	(0.005)	(0.006)
ln (B/M)	0.022**	0.027**	0.023**	0.022**
	(0.007)	(0.005)	(0.009)	(0.005)
Momentum		−0.027**		−0.035**
		(0.007)		(0.008)
Investment		0.033		0.019
		(0.025)		(0.027)
SO		0.009		0.006
		(0.009)		(0.009)
IP protection		−0.005		−0.003
		(0.003)		(0.004)
IP protection X SO		0.018**		0.013
		(0.008)		(0.008)
Constant	−0.006**	−0.171*	−0.058	−0.068
	(0.107)	(0.103)	(0.099)	(0.108)
Year dummy	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes
R-square (%)	8.6	8.8	7.8	8.02
Observations	15,360	15,228	12,049	11,956
First stage (Pat flow/S)				
R&D/Pat	−0.008**	−0.082**	−0.095**	−0.091**
	(0.001)	(0.020)	(0.013)	(0.026)
R&D/Tech	0.020	0.050	0.130	0.292**
	(0.177)	(0.091)	(0.216)	(0.109)
Patent law firms	−0.129 (0.223)	0.120 (0.164)	−0.135 (0.269)	0.603** (0.194)
J stat. for valid instruments	0.897 [0.639]	3.640 [0.162]	1.003 [0.606]	4.808 [0.090]

Note: Heteroscedasticity-consistent standard errors are shown in parentheses.
* Indicate the coefficient is statistically significant at the 10-percent level.
** Indicate the coefficient is statistically significant at the 5-percent level.

The coefficients for standardized patent flow for both groups are positive and significant at 5% significance level.

Panel B reports the results of the 2SLS regressions that employ the three IVs used in Table 3, namely, the private R&D-to-patent ratio, the R&D-to-scientists & engineers ratio, and the IP protection index. The J-statistics justifies the use of these three IVs, and the second-stage estimation strongly supports the positive effect of patent flow on subsequent stock returns.

5. Concluding remarks

The authors believe that the findings in this study uniquely benefit Asian business through their valuable policy implications. One unique feature that distinguishes most of the Asian countries from the Western developed countries is that the former usually have enormous degrees of unbalanced economic growth across various geographic regions. This huge inequality is social-welfare suboptimal and creates many problems. This research, by documenting the real effects of regional financial market development and the roles of regional intellectual property protection, provides a remedy to the problem of inequality. Specifically, one policy implication for government is the need to reform poorly regulated financial industries that were part of the problem (for instance, one drawback of China's financial system is that the Big Four state-owned banks systematically discriminate against smaller enterprises and favor bigger and more established companies) and to encourage financing of promising entrepreneurs and ventures, especially in the less developed regions, without charging them inappropriate rents. Another policy implication is that government, both central and regional, should do whatever is in their power to protect intellectual properties and punish piracy. This will effectively motivate firms to invest in innovation and encourage financial market participants to appreciate intellectual property.

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